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Maritimes Region | **Région des Maritimes**

Proceedings of the Maritimes Region Science Advisory Process on the Recovery Potential Assessment of Atlantic Mud-piddock (*Barnea truncate*)

September 30 – 1 October 2010

Bedford Institute of Oceanography
Dartmouth, Nova Scotia

Thomas W. Sephton
Meeting Chair

Compte rendu de la réunion du Processus consultatif scientifique de la Région des Maritimes au sujet du potentiel de rétablissement de la pholade tronquée (*Barnea truncate*)

Du 30 septembre au 1 octobre 2010

Institut océanographique de Bedford,
Dartmouth (Nouvelle-Écosse)

Thomas W. Sephton
président de la réunion

Bedford Institute of Oceanography / Institut océanographique de Bedford
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September 2011 | **Septembre 2011**

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenues dans le présent rapport puissent être inexactes ou propres à induire en erreur, elles sont quand même reproduites aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considérée en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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TABLE OF CONTENTS

SUMMARY / SOMMAIRE iv

INTRODUCTION 1

REVIEW OF THE STATUS OF ATLANTIC MUD-PIDDOCK 2
Recovery Potential Assessment for Atlantic Mud-piddock, *Barnea truncate* 2
Recovery Potential Assessment: Addressing the Terms of Reference 4

REVIEW OF SCIENCE ADVISORY REPORT 6

NEXT STEPS 6

CLOSING REMARKS 7

REFERENCES 7

APPENDICES 8
Appendix 1 Terms of Reference 8
Appendix 2 Agenda 11
Appendix 3 List of Participants 12

SUMMARY

A Maritimes Region Science Regional Advisory Process (RAP) was conducted on September 30 – 1 October 2010, at the Bedford Institute of Oceanography in Nova Scotia to conduct a recovery potential assessment for Atlantic Mud-piddock (*Barnea truncata*). Participation in this meeting included Fisheries and Oceans Canada (DFO), Nova Scotia Museum of Natural History and aboriginal communities. The results of this meeting are expected to be considered in the listing decision for Atlantic Mud-piddock.

SOMMAIRE

Dans le cadre du Processus consultatif scientifique de la Région des Maritimes, on a tenu une réunion du 30 septembre au 1 octobre, 2010, au l'Institut océanographique de Bedford de la Nouvelle Écosse afin de procéder à une évaluation du potentiel de rétablissement de la pholade tronquée (*Barnea truncata*). Y participaient des membres du personnel de Pêches et Océans Canada, (MPO), ainsi que des représentants du musée de la histoire naturelle de la Nouvelle Écosse et de communautés autochtones. Il devrait être tenu compte des résultats de la réunion dans la décision qui sera prise au sujet de l'inscription éventuelle de la pholade tronquée sur la liste des espèces en péril.

INTRODUCTION

T. Sephton (Chair) began the Recovery Potential Assessment (RPA) for Atlantic Mud-piddock by welcoming participants (Appendix 3) which was followed by a round of introductions. The context and administrative issues for the meeting were reviewed as well as the Terms of Reference (Appendix 1). It was noted that this was a science advisory meeting and, as such, would be focussed on the development of science advice based on the weight of the scientific evidence as opposed to the management implications of the advice. Everyone was invited to participate fully in the discussion and contribute knowledge to the process, with the intent of delivering a scientifically defensible product. The Agenda (Appendix 2) was reviewed, and nothing further was added.

The objective of the meeting was to determine the recovery potential of Atlantic mud-piddock. Specifically, to the extent possible with the available information, and taking account of uncertainties:

Status and Trends

1. Evaluate present abundance and range.

2. Evaluate recent trajectory for species abundance and range.

3. Estimate, to the extent that information allows, the current or recent life-history parameters (total mortality, natural mortality, fecundity, maturity, recruitment, etc.) or reasonable surrogates; and associated uncertainties for all parameters.

Habitat Considerations

4. Provide functional descriptions (as defined in DFO 2007b) of the properties of the aquatic habitat that the Atlantic mud piddock needs for successful completion of all life-history stages.

5. Provide information on the spatial extent of the areas in the Atlantic mud-piddock's range that are likely to have these properties.

6. Quantify the presence and extent of spatial configuration constraints, if any, such as connectivity, barriers to access, etc.

7. Provide advice on the degree to which supply of suitable habitat meets the demands of the species both at present, and when the species reaches biologically based recovery objectives.

8. Provide advice on any tradeoffs (i.e., pros and cons) associated with habitat "allocation" options, if any options would be available at the time when specific areas may be designated as Critical Habitat.

9. Evaluate residence requirements, if any.

10. Recommend research or analysis activities that are necessary in order to complete these habitat-use Terms of Reference if current information is incomplete.

Recovery Objectives

11. Estimate expected abundance and distribution objectives for recovery, according to DFO guidelines (DFO 2005).

Threats

12. Quantify to the extent possible the magnitude of each major potential source of mortality identified in the COSEWIC Status Report, information from DFO sectors, and other sources.

13. Identify the activities most likely to result in threats to the functional properties of the habitat of Atlantic Mud-piddock, and provide information on the extent and consequences of these activities within the species' range.

14. Assess to the extent possible how threats to habitats identified in the COSEWIC Status Report (COSEWIC 2009) have reduced habitat quantity and quality to date, if at all.

Mitigation and Alternatives

15. Using input from all DFO sectors and other sources as appropriate develop an inventory of potential measures that could be used to minimize/mitigate the impacts of activities identified in Steps 13 and 14.

Assessment of Recovery Potential

16. Given current dynamics parameters and associated uncertainties, project expected population trajectories over three generations (or other biologically reasonable time), and trajectories over time to the recovery objectives, using DFO guidelines on long-term projections (Shelton et al. 2007).

REVIEW OF THE STATUS OF ATLANTIC MUD-PIDDOCK

Day One: September 30, 2010

Recovery Potential Assessment for Atlantic Mud-Piddock, *Barnaea truncate*

Working Paper Presentation: Baseline Document for Recovery Potential Assessment for the Atlantic Mud Piddock (*Barnea truncata*). Andrew Hebda, NS Museum of Natural History.

Presentation Highlights:

The presentation started with a general overview of what little is known about the Atlantic Mud-piddock as was summarised in the original COSEWIC assessment and status report. This included the taxonomy and description of the species, the basic biology of bivalve molluscs as filter feeders as nothing specific is know for *B. truncata*, , the estimated range of temperature and salinity tolerances based on its geographic distribution and the general nature of bivalve broadcast spawning and free swimming larval dispersal. *B. truncata is a* lithophagous species and its Canadian distribution is restricted to a particular substrate habitat: soft red mudstone facies found in the Minas Basin. Based on field observations, the metamorphosed larva bores at right angles to the surface upon which they settle and, as it grows, it continues to bore along this initial axis. Because the size of the hole increases in diameter with growth of the adult, this

results in a conical bore-hole. Consequently the adult is trapped for life inside its burrow. This differentiates it from the circular boring of co-occurring species such as *Petricolaria pholadiformis* which produces a cylindrical bore-hole and was used as a diagnostic feature for differentiating the 2 species in the rock substrate.

An extensive field program in 2007 to 2008 and further reconnaissance in 2009 - 2010 confirmed the occurrence in only one substrate type in intertidal portions of the Minas Basin but not in other parts of the Bay of Fundy, and based on historic surveys, not in the Northumberland straits or Atlantic coast of Nova Scotia. The presence of large bodies of sands and muds in most sub-tidal portions of the basin preclude its persistence in those parts of the basin and these areas were easily determined from aerial photographs taken at low tide (and those areas were excluded from the field surveys). It may be present where appropriate substrate exists sub-tidally where there are no sediment accumulation occurs. Although the Atlantic Mud-piddock is restricted to one substrate type, it was found in three types of habitat in field investigations between 2007-2010:

- Embedded under a more-resistant "capstone" substrate,
- Associated with more-resistant bedrock features such as large cobbles or other exposed rock material, and
- In exposed surfaces including rock pools where resistant rock has been eroded (probably through ice scour or movement of rock-like materials during tidal exchange).

There is no current estimate of abundance or densities of *B. truncata* in Canadian waters nor is there anything known of its genetic phylogeny with other populations along the eastern seaboard of the United States (e.g. Maine), it's basic life history, natural mortality, reproductive capacity or recruitment potential.

The evaluation of Atlantic Mud-piddock by the Committee of the Status of Endangered Wildlife in Canada (COSEWIC) as threatened, and the process to date for the consideration for listing under the *Species at Risk Act (SARA)* were described. Basically, any changes in deposition of sediments can smother individuals or cover entire areas of habitat. Disturbances that change the sediment depositional regime are considered the main threat. Most serious is the increased frequency and severity of storms, due to climate change, which have the potential to rapidly bury habitat and smother individuals. It is expected that erosion from rising sea levels (storm surges) and increased rainfall (floods), would also contribute to habitat loss by sediment deposition. Proposed development in the basin could also alter or add to sediment deposition. The Canadian population is clearly disjunct from the nearest population, 350 km south, in Maine, and rescue is very unlikely.

Discussion and Reviewers Comments:

The two reviewers provided specific comments and corrections on the working paper that will allow it to be transformed into a research document. This included double checking the references cited, adding sampling dates to the summary tables, including better maps showing distribution and the inclusion of a recent 2009 paper published on the genus phylogeny.

The term 'relic population' was defined and the methodology was described to determine the 'extent of area' from the aerial photographs used in the field survey.

There was a question about the possible competition of habitat space by the 2 co-occuring species of pholatids. It was explained that it was actually the *Barnea* holes that attracted the *Petricolaria* to use abandoned or empty burrows as the *Petricolaria* could not make holes in this type of rock. It was also noted that *Barnea* continually exposes new substrate for recruitment,

particularly that embedded under a more-resistant "capstone" substrate, as its burrowing abilities naturally weakens the red mudstone and makes the rock more susceptible to erosion by storm events and ice scour.

Little is known about this species other than it's reliance on a specific substrate for adult habitat.

Recovery Potential Assessment: Addressing the Terms of Reference

A. Hebda, NS Museum of Natural History.

Presentation Highlights:

Status and Trends

Distribution: In Canadian waters the species is restricted, to the Minas Basin of the Bay of Fundy. Within this basin, it is found at several discrete sites that can be generalised to three locations – Inner Basin, Outer Basin and Avon Estuary.

Abundance: In order to get appropriate population estimates for the Minas Basin, it would be necessary to undertake disruptive and destructive sampling through removal of capstone protection at selected sites, then cutting cross-sections through bore-hole assemblages. In areas surveyed, capstone thickness varied up to 80 cm in depth. Consequently there is no current estimate of abundance or densities of *B. truncata* in Canadian waters.

Recent Trajectory for Species Abundance and Range

In the absence of any systematic sampling or monitoring activity since the recording of the species in Canadian waters in 1959, there are no data to use as a basis for trajectory evaluation. There is no evidence for successful colonization outside the Minas Basin.

Recent Life History Parameters - As can be seen in the background information provided in the working paper, there is very little know about this species anywhere throughout its range.

Natural Mortality: Natural mortality in these Canadian Populations probably occurs in four ways.

- Loss of larvae through consumption by filter-feeders or through export by tidal flushing
- Loss of adults through substrate alteration (collapse of cap-stone cover or grinding off by movement of ice or rock materials and)
- Loss through old age
- Loss through sediment incursion onto bore-holes/burrows

Habitat Considerations

Ranges offered reflect regional ranges (eg. Temperature requirement and tolerance in Sub-Saharan African estuarine waters may not be the same as those for Minas Basin populations – no data available in the literature.) The difficulty in defining these in a Canadian context is that this population is well outside the latitudinal range of other global populations.

Adults

Water Depth – Intertidal (mid tidal range) – to possible sub-tidal range - undefined although there is some evidence of larval settlement in pools in upper intertidal zone. In this ecosystem, the majority of the populations documented appear to be just below the mid-tidal range

Salinity – 16-30 ppt (inferred)
Temperature – 2 - 30° C (inferred) – need temperature change to induce spawning.
Current – adequate (during each tidal cycle) to prevent sediment accumulation (speeds undefined)
Turbidity - unknown, although food items (planktonic and other particulates) must be adequate
Oxygen – due to its confinement in substrate (inability to move), it has a requirement for well-oxygenated waters.
Substrate Composition – firm mudstone facies.
Location - must not be subject to significant variation in sediment deposition. Must have a degree of protection from scouring by currents (especially at highest current speeds), from moving rock material (cobbles, coarse sand etc.) as well as from moving and resting ice, especially in late winter.

Larvae

Water: Highly oxygenated and productive shallow water for both trochophore and veliger stages.

Substrate: Settlement is thought to occur at high-slack tide, so substrate of appropriate texture and density is required. Larvae are not able to start boring in hard or complex substrates containing hard elements (sands). Since successful settlement is dependent on sufficient time to initiate boring and derive protection from the bore-hole/burrow before de-watering with the falling tide, it appears that, ideally this would be from mid-tidal point and lower. Successful establishment has been noted in tide pools in upper intertidal areas, but such areas tend to be subject to factors limiting the persistence of adults.

Spatial Extent of Areas that are Likely to have these Properties: There is only a narrow band of habitats in the mid-low or even sub-tidal portions of the Minas Basin where one finds substrate suitable for settlement. The majority of sites are at points where this mud-stone facies is exposed under firmer rock beds. There are only 42 ha of surveyed substrate that fit into this category, with a possible additional 15 ha which were inaccessible during field surveys.

Spatial Constraints: Except in areas associated with headlands, most of the sites with populations of *B. truncata* are isolated from each other by areas of mud-flats or in the mid-basin, stable masses of sands and other coarse sediments. However, since the species is not mobile in its adult form and larvae are carried throughout the basin and further, by tidal currents, this is not a barrier.

Supply of Habitat Meeting Demands: At present, the populations of *B. truncata* in the basin are relatively stable. There is some loss of sub-populations, some constraint at margins of others, but due to the relative refreshing of substrates at some sites and evidence for ongoing recruitment/ settlement at most sites, there is an adequate supply of habitat to maintain sustainable populations within the basin unless there are catastrophic changes (e.g. storm or pollution events) or long-term degradation to the ecosystem.

Habitat Allocation Options: As was outlined in Status and Trends (Abundance), it would appear that the most important habitats from the point of recruitment and persistence of the species in the basin are probably the sites with populations associated with cap-stone habitats, followed by those deriving protection from other features such as cobble beds etc., with open pool-type habitats being the least significant (or persistent). In the presence of such a limited amount of habitat allocation options may be limited.

Residence Requirements

Research and Analysis Required: At present there are substantial gaps in our knowledge of the species, its habitat use and our understanding of why it uses habitats (in Canadian waters) that are so different from those within the rest of its global range. However several questions should be addressed in order to place management of the species or threats to the species on firmer ground. These include:

- Confirmation of life history traits - life span, age to sexual maturity, time of reproductive activity
- Confirmation of presence or absence of the species in approximately 15 ha of isolated habitats
- Evaluation of field sites with current silt loading (mud flats) overlaying mud-stone facies to determine if there are other sites within the basin that have been lost due to siltation events and
- Genetic analysis to confirm relationship between nearest sustaining populations (Massachusetts) and southern populations – is this one species or a species complex with intergrades?

Discussion:

As was noted earlier, little is known about this species other than it's reliance on a specific substrate for adult habitat. The population appears to be stable. The concept of recovery was discussed and noted that the meeting would not be able to define either a qualitative or interim target.

REVIEW OF THE SCIENCE ADVISORY REPORT (SAR)

The draft SAR was reviewed for the remainder of the day and completed on Day 2 of the meeting. A general consensus was reached for all sections after some discussion amongst all participants and the document was fine tuned.

Day Two: October 1, 2010

The SARA office prepared a summary table of the threats, potential impacts and recommended management outcomes that were discussed in advance with Habitat Management advisors. The table was reviewed by the meeting participants and it was agreed that it be included as a summary in the SAR. Since all the threats are habitat related, the eventual designation will naturally describe the critical habitat for *B. truncata*.

NEXT STEPS

The working paper will be revised and submitted as a research document. All figures that are used in the SAR should be included in the research documents with more detailed descriptions.

The SAR will be run through an editorial meeting and circulated to participants when completed. It will eventually be posted to the CSAS website www.dfo-mpo.gc.ca/csas

CLOSING REMARKS

The meeting ended with sincere thanks extended to all participants from the Chair for a very thoughtful and fruitful discussion of the limited information available for the Atlantic Mud-piddock.

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COSEWIC. 2009. COSEWIC Assessment and Status Report on the Atlantic Mud-piddock (*Barnea truncata*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

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APPENDICES

Appendix 1. Terms of Reference

Recovery Potential Assessment (RPA)
for Atlantic Mud-piddock (*Barnea truncata*)

Maritimes Region Science Advisory Process Meeting

Hayes Boardroom
Bedford Institute of Oceanography
Chairperson: Tom Sephton

30 September (pm) – 1 October (am) 2010

TERMS OF REFERENCE

Context

When the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designates aquatic species as threatened or endangered, DFO, as the responsible jurisdiction under the *Species at Risk Act* (SARA), is required to undertake a number of actions. Many of these actions require scientific information on the current status of the species, population or designable unit (DU), threats to its survival and recovery, and the feasibility of its recovery. Formulation of this scientific advice has typically been developed through a Recovery Potential Assessment (RPA) that is conducted shortly after the COSEWIC assessment. This timing allows for the consideration of peer-reviewed scientific analyses into SARA processes including recovery planning decisions.

The Atlantic Mud-piddock, a small intertidal marine bivalve, is restricted to a single population in the Minas Basin, Nova Scotia. Although this species is adapted to boring into hard clay and soft rock, in Canada it is entirely dependent on a single geological formation, the red-mudstone facies within the basin. The total available habitat for this species is < 0.6 km^2. It was designated by COSEWIC as Threatened in November 2009 due to its small area of occupancy.

DFO Science has been asked to undertake an RPA, based on the National Framework (DFO 2007a). The advice generated via this process will also update any existing advice regarding this species.

Objectives

The overarching objective of this meeting is to determine the recovery potential of Atlantic Mud-piddock. Specifically, to the extent possible with the information available, and taking account of uncertainties:

Status and Trends

17. Evaluate present abundance and range.

18. Evaluate recent trajectory for species abundance and range.

19. Estimate, to the extent that information allows, the current or recent life-history parameters (total mortality, natural mortality, fecundity, maturity, recruitment, etc.) or reasonable surrogates; and associated uncertainties for all parameters.

Habitat Considerations

20. Provide functional descriptions (as defined in DFO 2007b) of the properties of the aquatic habitat that the Atlantic mud piddock needs for successful completion of all life-history stages.

21. Provide information on the spatial extent of the areas in the Atlantic Mud-piddock's range that are likely to have these properties.

22. Quantify the presence and extent of spatial configuration constraints, if any, such as connectivity, barriers to access, etc.

23. Provide advice on the degree to which supply of suitable habitat meets the demands of the species both at present, and when the species reaches biologically based recovery objectives.

24. Provide advice on any tradeoffs (i.e., pros and cons) associated with habitat "allocation" options, if any options would be available at the time when specific areas may be designated as Critical Habitat.

25. Evaluate residence requirements, if any.

26. Recommend research or analysis activities that are necessary in order to complete these habitat-use Terms of Reference if current information is incomplete.

Recovery Objectives

27. Estimate expected abundance and distribution objectives for recovery, according to DFO guidelines (DFO 2005).

Threats

28. Quantify to the extent possible the magnitude of each major potential source of mortality identified in the COSEWIC Status Report, information from DFO sectors, and other sources.

29. Identify the activities most likely to result in threats to the functional properties of the habitat of Atlantic Mud-piddock, and provide information on the extent and consequences of these activities within the species' range.

30. Assess to the extent possible how threats to habitats identified in the COSEWIC Status Report (COSEWIC 2009) have reduced habitat quantity and quality to date, if at all.

Mitigation and Alternatives

31. Using input from all DFO sectors and other sources as appropriate, develop an inventory of potential measures that could be used to minimize/mitigate the impacts of activities identified in Steps 13 and 14.

32. Using input from all DFO sectors and other sources as appropriate, develop an inventory of potential alternatives to the activities identified in Steps 13 and 14.

33. Using input from all DFO sectors and other sources as appropriate, develop an inventory of activities that could increase the productivity or survivorship parameters identified in Step 3.

34. Provide advice on feasibility of restoring habitat to higher values, if supply may not meet demand by the time recovery targets would be reached.

35. Estimate, to the extent possible, the expected impact on abundance and distribution objectives from identified mitigation measures (Step 16), alternatives (Step 17), or recovery activities (Steps 18 and 19).

Assessment of Recovery Potential

36. Given current dynamics parameters and associated uncertainties, project expected population trajectories over three generations (or other biologically reasonable time), and trajectories over time to the recovery objectives, using DFO guidelines on long-term projections (Shelton *et al.* 2007).

37. Given alternative mortality rates and productivities associated with specific scenarios identified in Step 17, project expected population trajectory over three generations (or other biologically reasonable time), and to the time of reaching recovery objectives.

38. Assess the probability that the recovery objectives can be achieved under current rates of dynamics parameters, and how that probability would vary with different mortality (especially lower) and productivity (especially higher) parameters.

Outputs

CSAS Science Advisory Report
CSAS Proceedings
CSAS Research Document

Participation

DFO Science
DFO Fisheries and Aquaculture Management, Oceans and Habitat Management, Policy and Economics, and the SARA Coordination Office
Aboriginal Communities
Parks Canada
Provinces of Nova Scotia and New Brunswick
External Reviewers
Industry
Non-governmental organizations
Other Stakeholders

References

COSEWIC. 2009. COSEWIC Assessment and Status Report on the Atlantic Mud-piddock (*Barnea truncata*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

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Appendix 2. Agenda

Recovery Potential Assessment (RPA)
for Atlantic Mud-piddock (*Barnea truncata*)

Maritimes Region Science Advisory Process Meeting

Hayes Boardroom
Bedford Institute of Oceanography
Chairperson: Tom Sephton

30 September (pm) -- 1 October (am) 2010

AGENDA

30 September 2010

13:00 - 13:15	Introduction
13:15 - 14:30	Presentation of Atlantic Mud-piddock Working Paper
14:30 -14:45	Break
14:45 – 16:15	Review of Analyses
16:15 - 16:30	Review
16:30	Adjournment

1 October 2010

9:00 - 9:10	Recap
9:10 -10:30	Review of Science Advisory Report (SAR)
10:30 -10:45	Break
10:45 -11:45	Review of SAR
11:45 -12:00	Review
12:00	Adjournment

Appendix 3. List of Participants

Recovery Potential Assessment (RPA)
for Atlantic Mud-piddock (*Barnea truncata*)

Maritimes Region Science Advisory Process Meeting

30 September (pm) -- 1 October (am) 2010

ATTENDEES

Name	Affiliation
Davis, Derek	NS Museum of Natural History
Hebda, Andrew	NS Museum of Natural History
Jayawardane, Aruna	Maliseet Nation Conservation Council
Kesick, Franz	Maritimes Aboriginal Peoples Council
MacIntosh, Robert	DFO Maritimes, Policy & Economics
Robichaud-LeBlanc, Kim	DFO Maritimes, SARA
Roddick, Dale	DFO Maritimes, Science
Sephton, Thomas W.	DFO Maritimes, CSAS, Chair
Silva, Angelica	DFO Maritimes, Science
Spence, Koren	DFO Maritimes , SARA
Themelis, Daphne	DFO Maritimes, Science